FIG.1

BLOCK DIAGRAM OF OPTICAL TRANSMISSION SYSTEM ACCORDING TO EMBODIMENT 1-1 OF PRESENT INVENTION

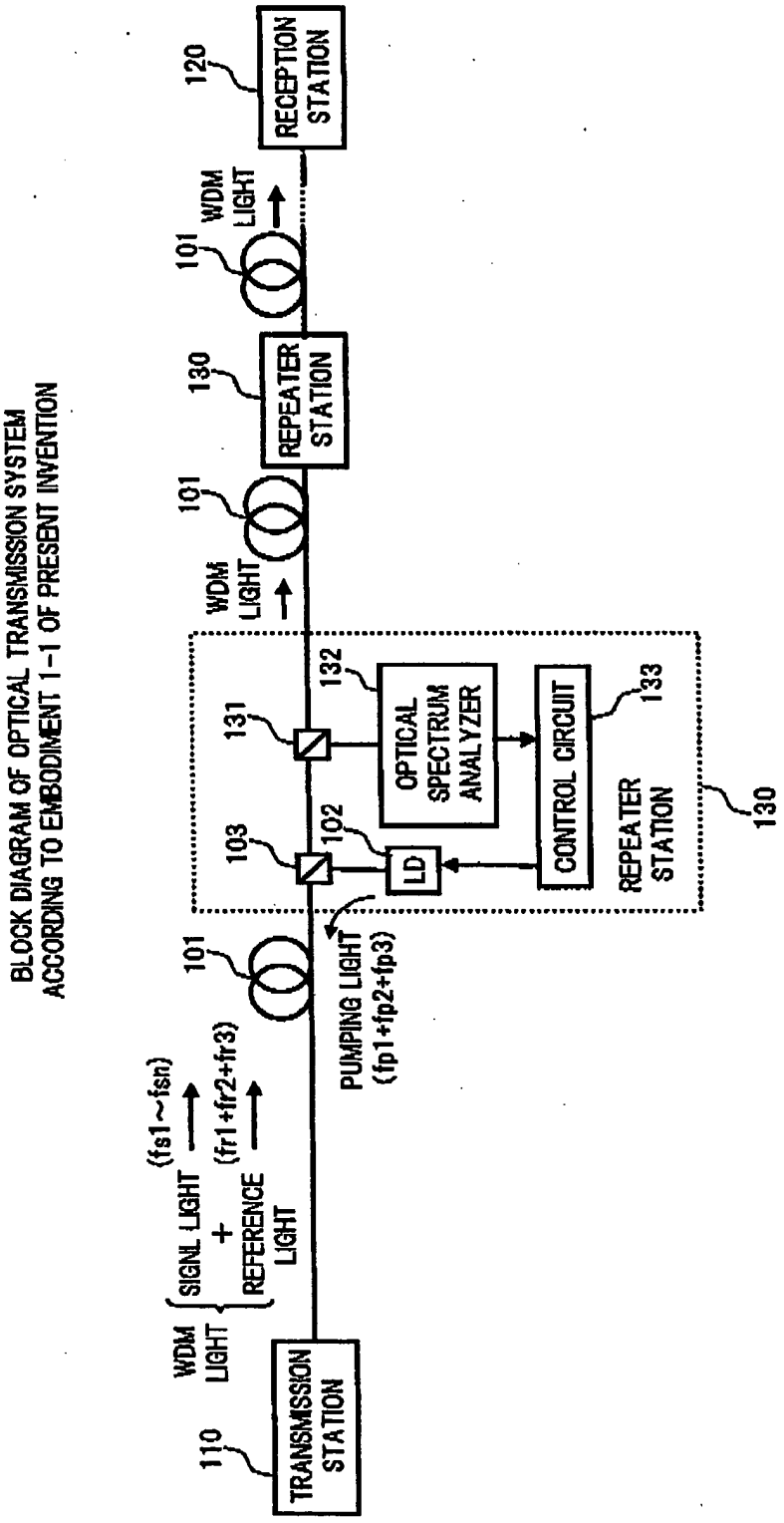


FIG.2

DIAGRAM EXPLAINING ARRANGING METHOD OF REFERENCE LIGHT

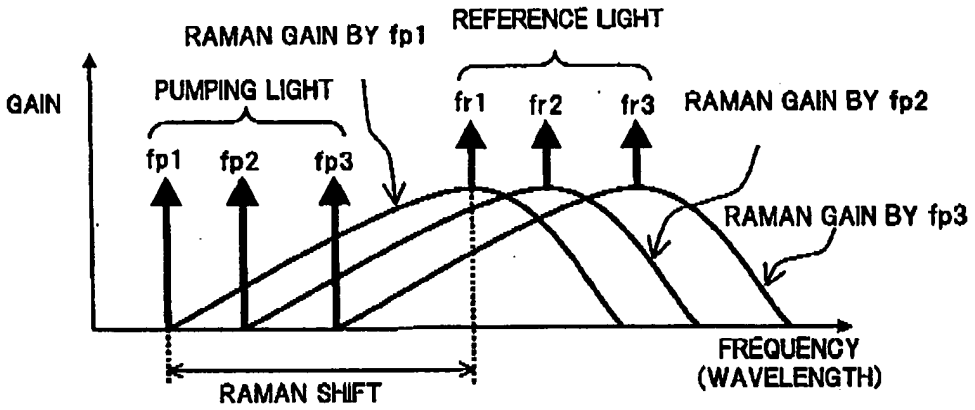


FIG.3

BLOCK DIAGRAM OF TRANSMISSION STATION

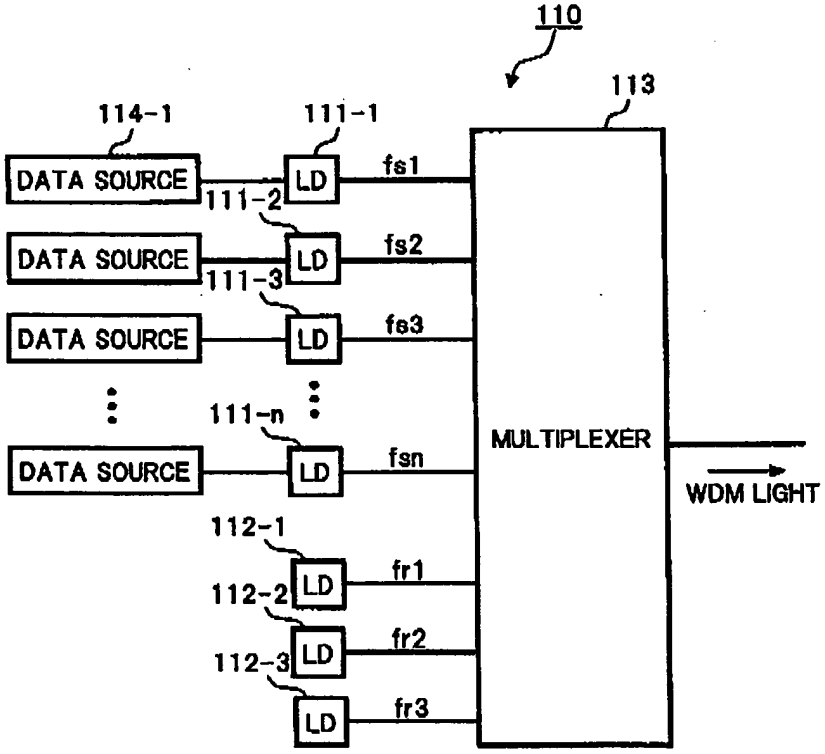


FIG.4

EXAMPLE OF TRANSMISSION CIRCUIT IN CASE WHERE DATA IS TRANSMITTED UTILIZING REFERENCE LIGHT

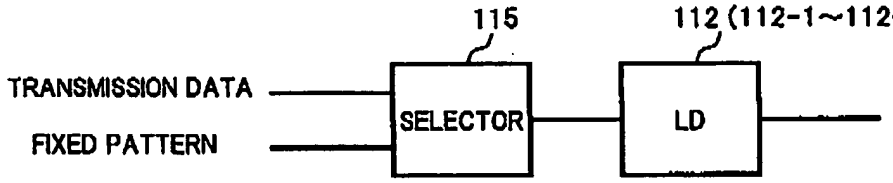


FIG.5

BLOCK DIAGRAM OF CONTROL CIRCUIT PROVIDED IN EACH REPEATER STATION

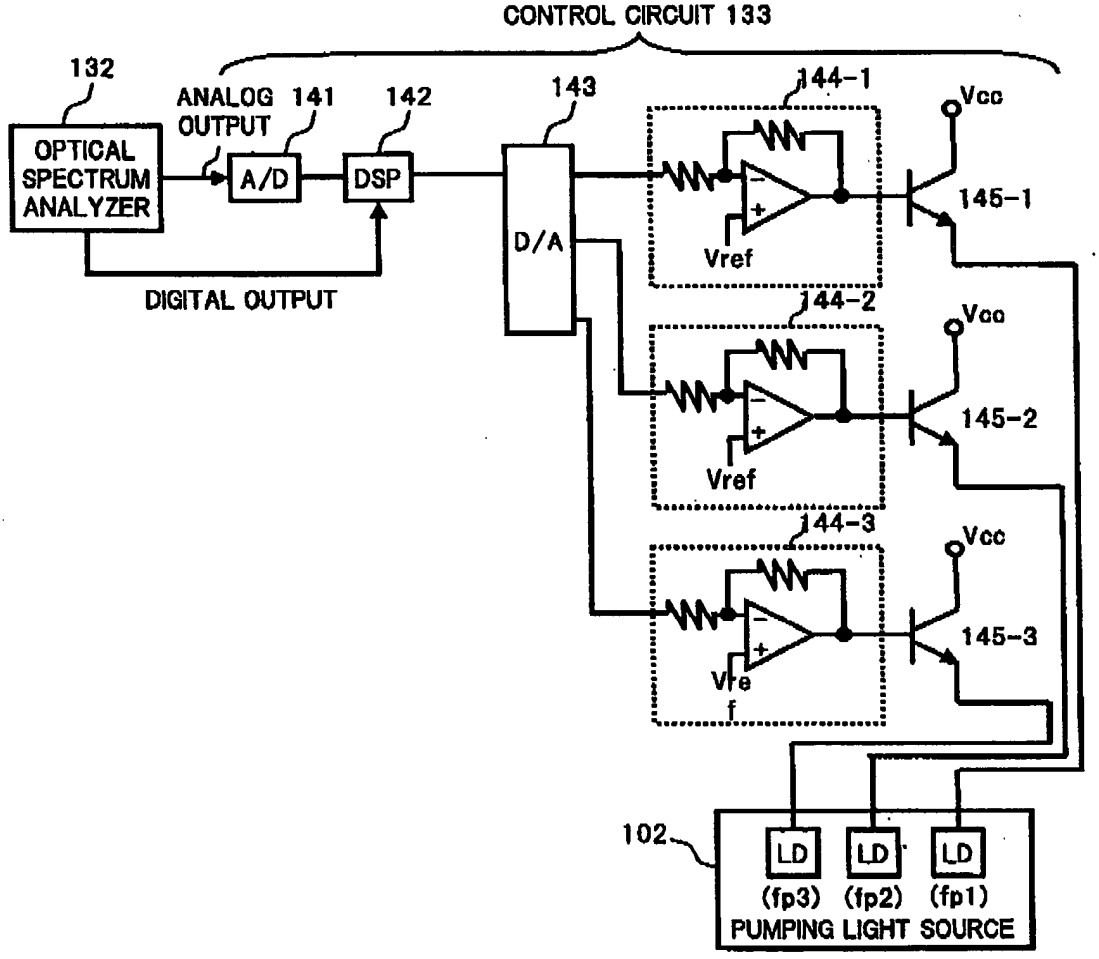


FIG.6

DIAGRAM EXPLAINING EFFECT OF OPTICAL TRANSMISSION SYSTEM ACCORDING TO EMBODIMENT 1-1

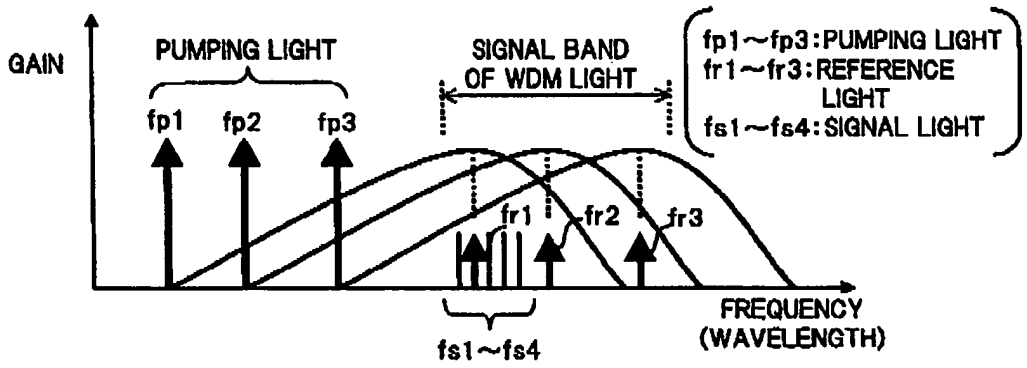


FIG.7

EMBODIMENT OF REPEATER STATION OPERATING BASED ON OPTICAL POWER OF WDM LIGHT

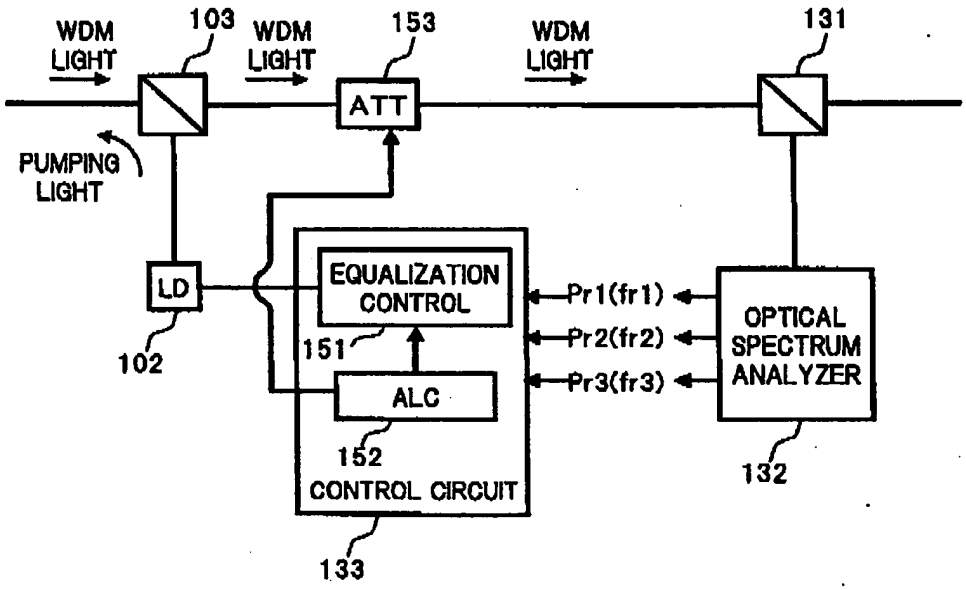
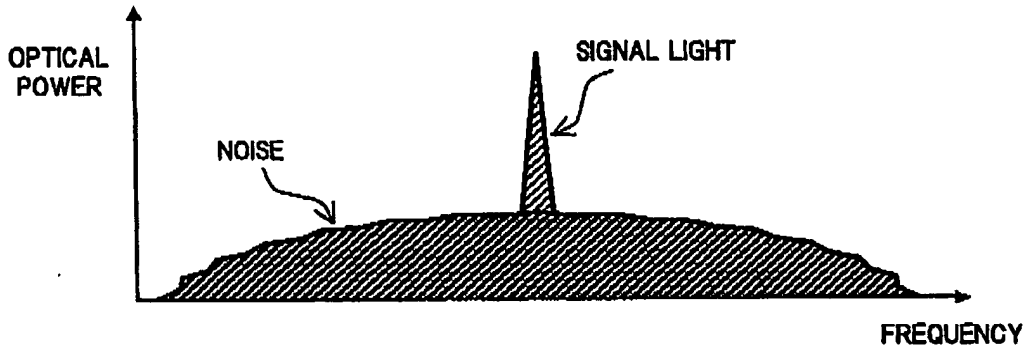


FIG.8

(a)
OPTICAL DETECTION IN CONVENTIONAL TECHNIQUE



(b)
DIAGRAM EXPLAINING OPTICAL DETECTION IN EMBODIMENT1-1

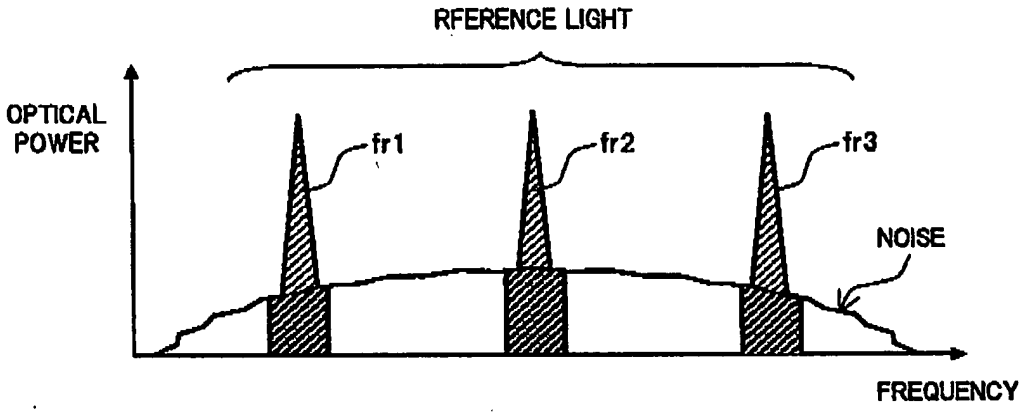


FIG.9

BLOCK DIAGRAM OF REPEATER STATION OF OPTICAL TRANSMISSION SYSTEM ACCORDING TO EMBODIMENT 1-2

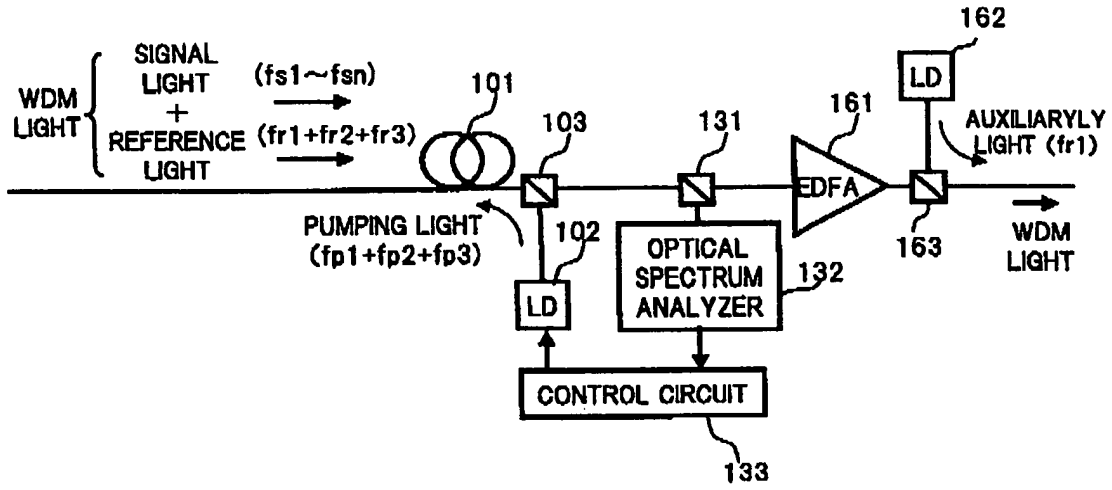


FIG.10

DIAGRAM EXPLAINING RELATION BETWEEN RAMAN AMPLIFIER AND EDFA

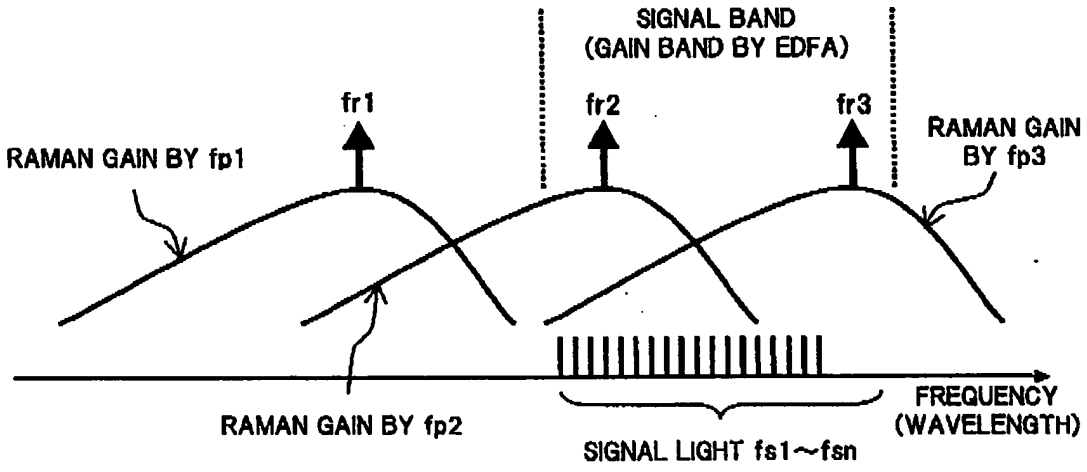


FIG.11

EMBODIMENT OF APPARATUS FOR DETECTING OPTICAL POWER OF REFERENCE LIGHT

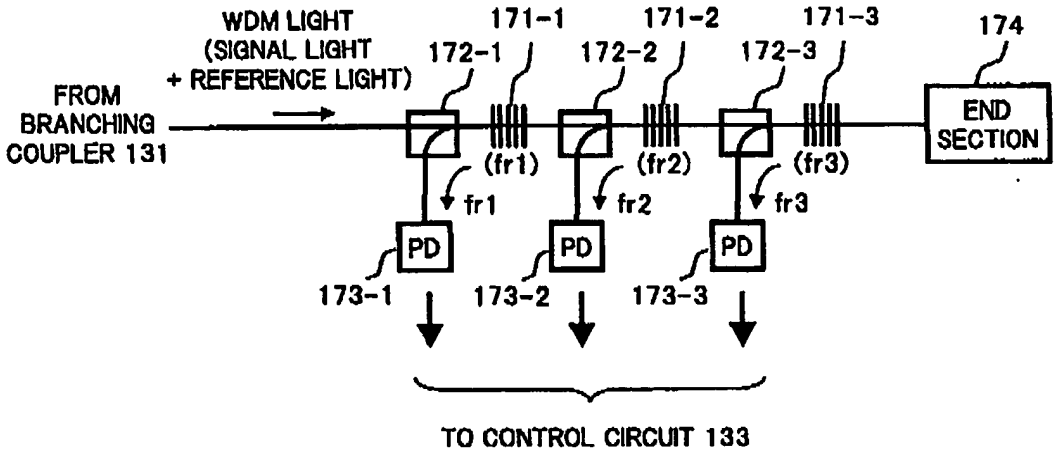


FIG.12

MODIFIED EXAMPLE OF DETECTING CIRCUIT SHOWN IN FIG. 11

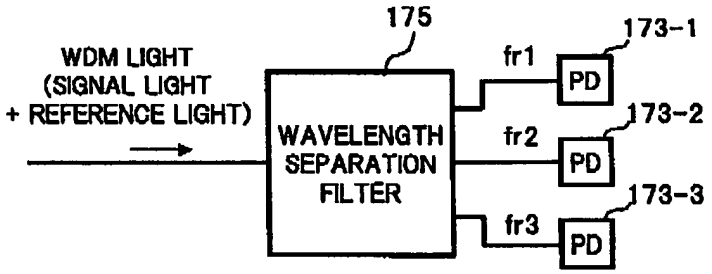


FIG.13

CONFIGURATION OF EMBODIMENT 2-1 OF PRESENT INVENTION

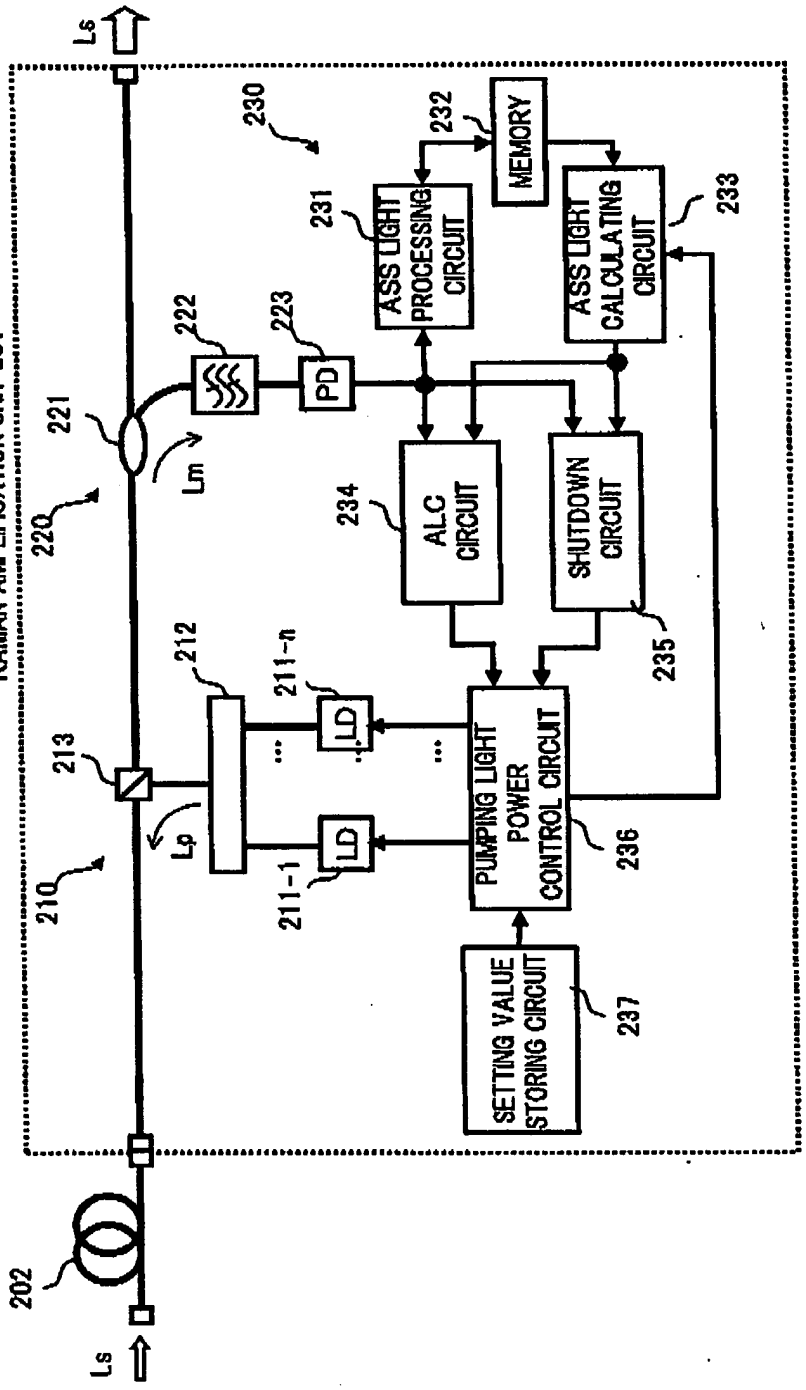


FIG.14

PROCESSING OF OBTAINING COEFFICIENT OF MODEL FORMULA FOR CALCULATING ASS LIGHT POWER

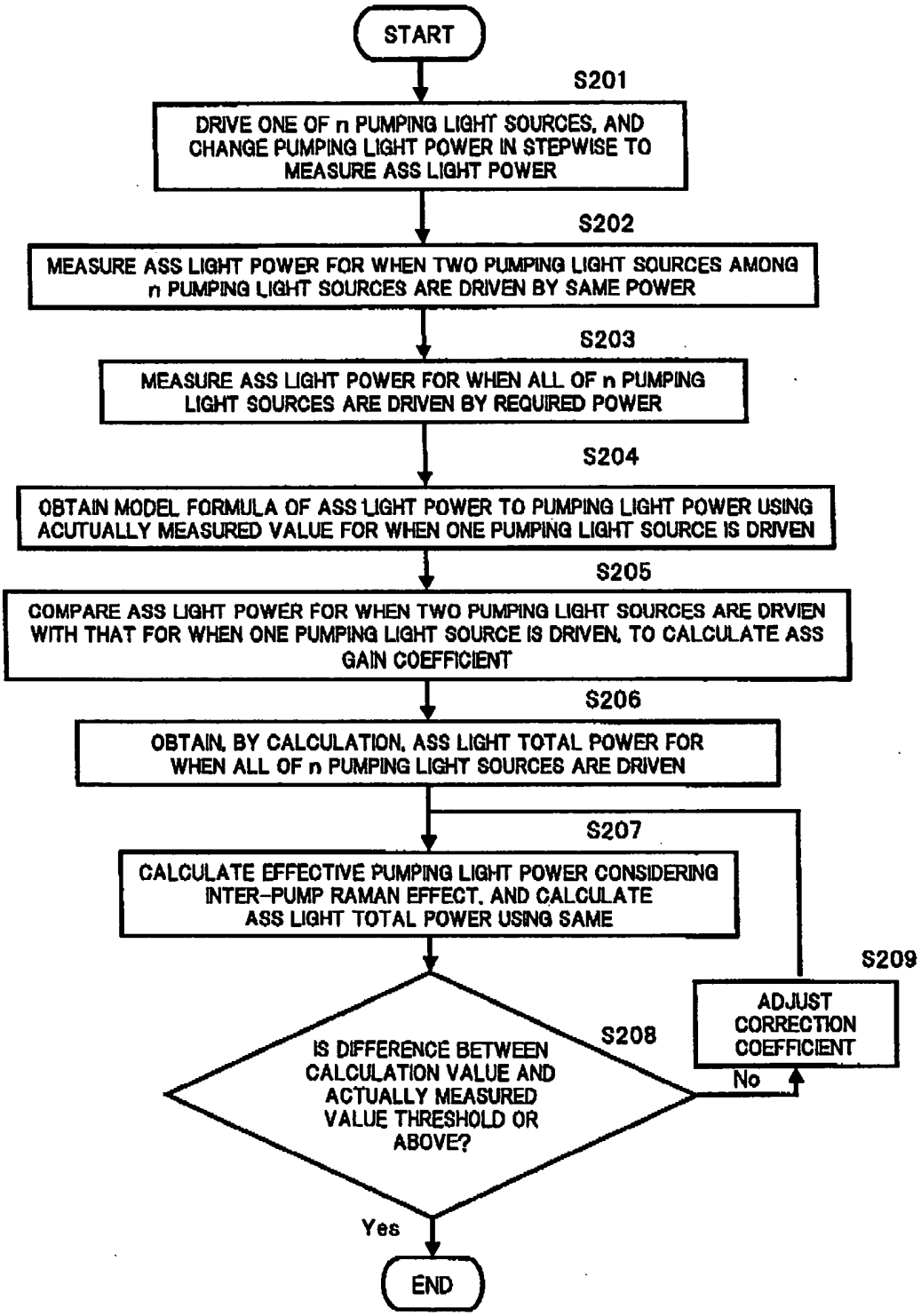


FIG.15

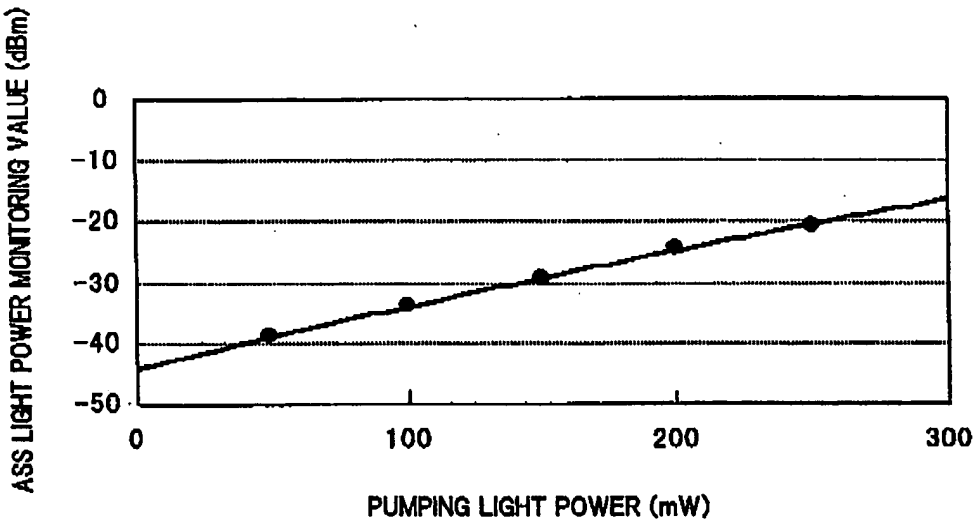

ASS LIGHT POWER MONITORING VALUE (dBm)
0
-10
-20
-30
-40
-50
0
100
200
300
PUMPING LIGHT POWER (mW)

FIG.16

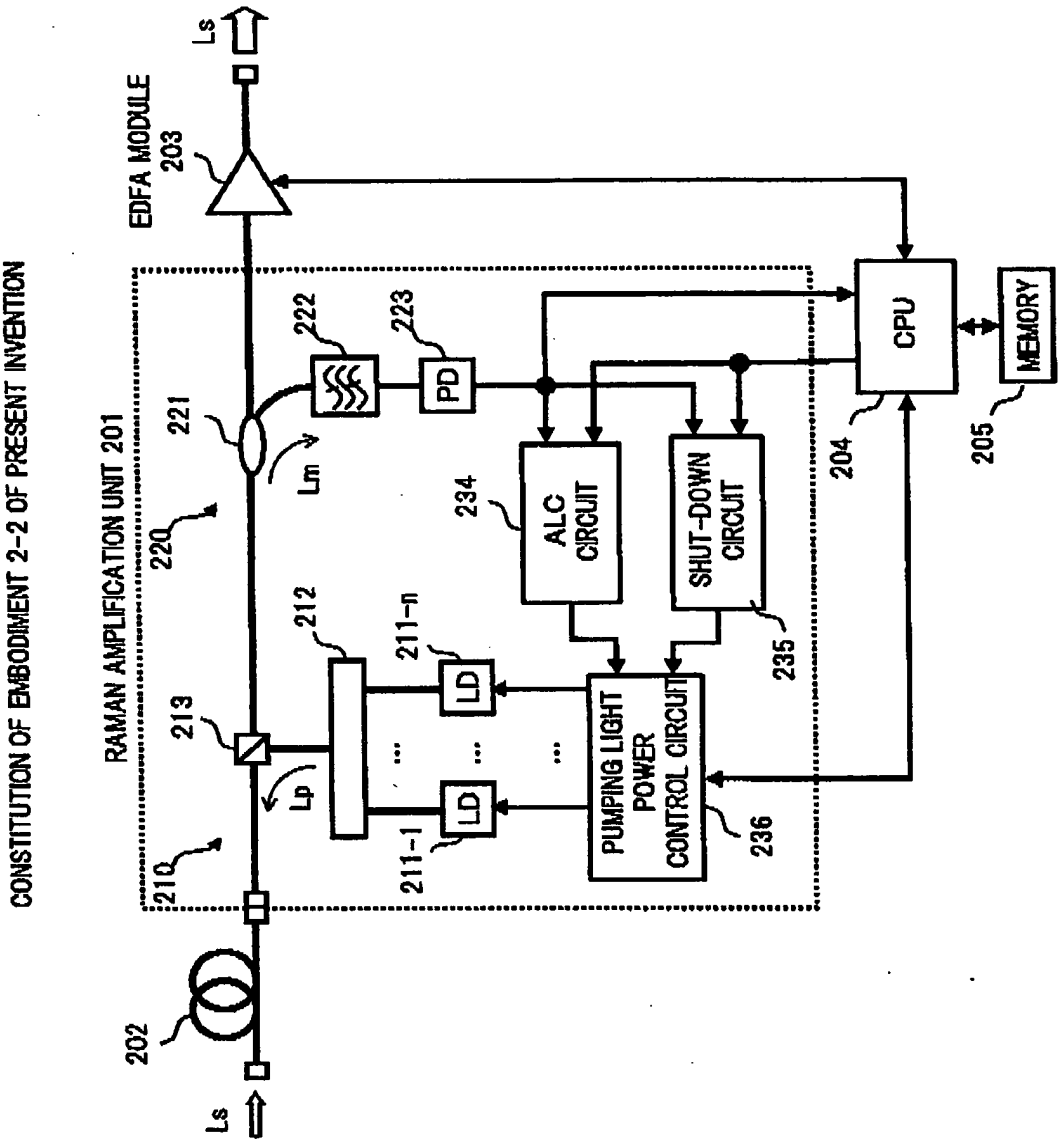

CONSTITUTION OF EMBODIMENT 2-2 OF PRESENT INVENTION
Ls
EDFA MODULE
203
RAMAN AMPLIFICATION UNIT 201
222
223
PD
221
Lm
220
234
ALC CIRCUIT
SHUT-DOWN CIRCUIT
CPU
MEMORY
204
205
212
211-n
LD
213
Lp
PUMPING LIGHT POWER CONTROL CIRCUIT
235
236
210
211-1
LD
202
Ls

FIG.17

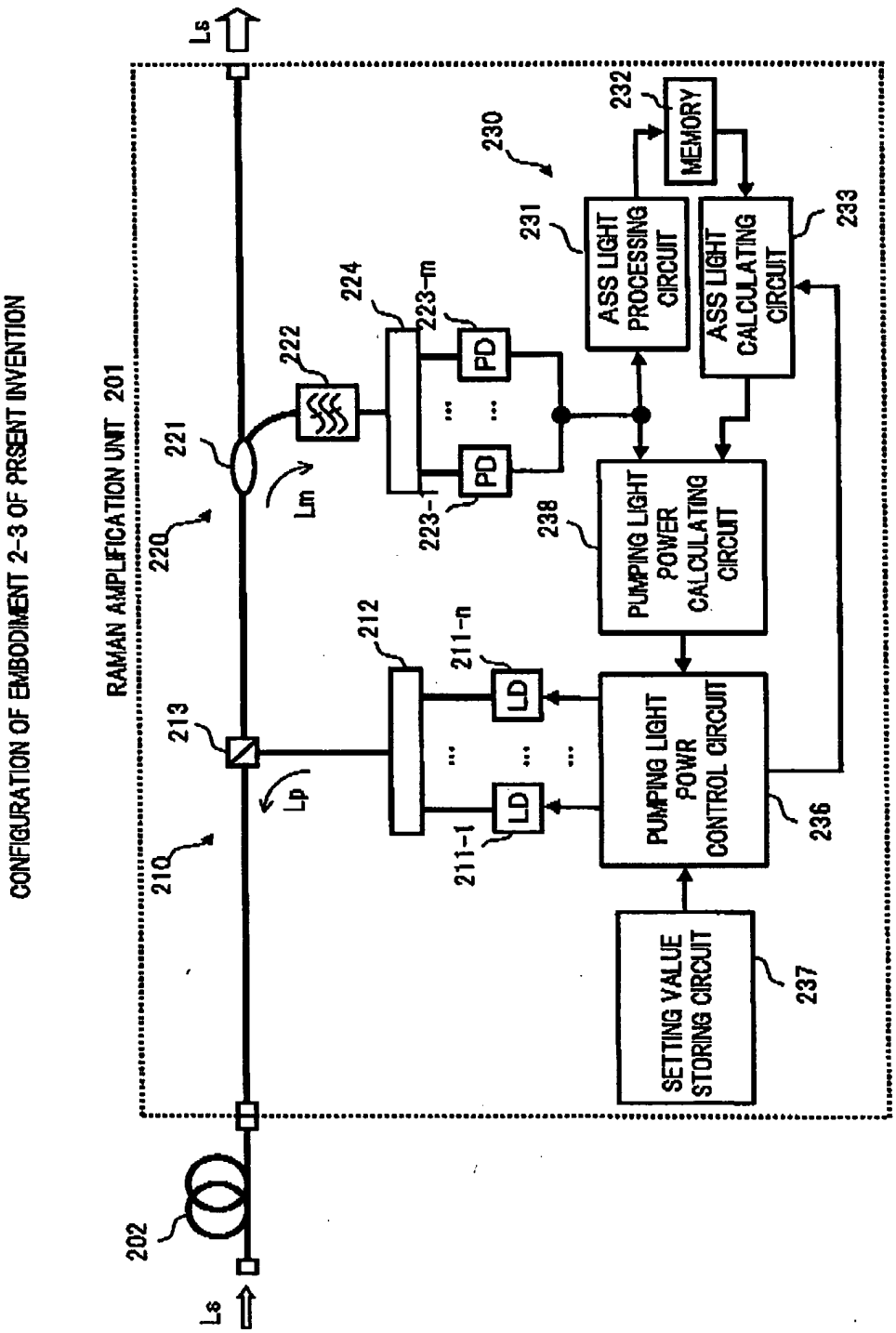

CONFIGURATION OF EMBODIMENT 2-3 OF PRSENT INVENTION
RAMAN AMPLIFICATION UNIT 201
Ls
Ls
202
210
220
221
222
223-m
223-1
224
Lm
Lp
211-1
211-n
212
213
LD
LD
PD
PD
230
231
232
233
ASS LIGHT PROCESSING CIRCUIT
MEMORY
ASS LIGHT CALCULATING CIRCUIT
238
PUMPING LIGHT POWER CALCULATING CIRCUIT
PUMPING LIGHT POWR CONTROL CIRCUIT
236
SETTING VALUE STORING CIRCUIT
237

FIG.18

PROCESSING OF OBTAINING SETTING VALUE OF PUMPING LIGHT POWER FOR OBTAINING OUTPUT SIGNAL LIGHT WITH DESIRED WAVELENGTH CHARACTERISTIC

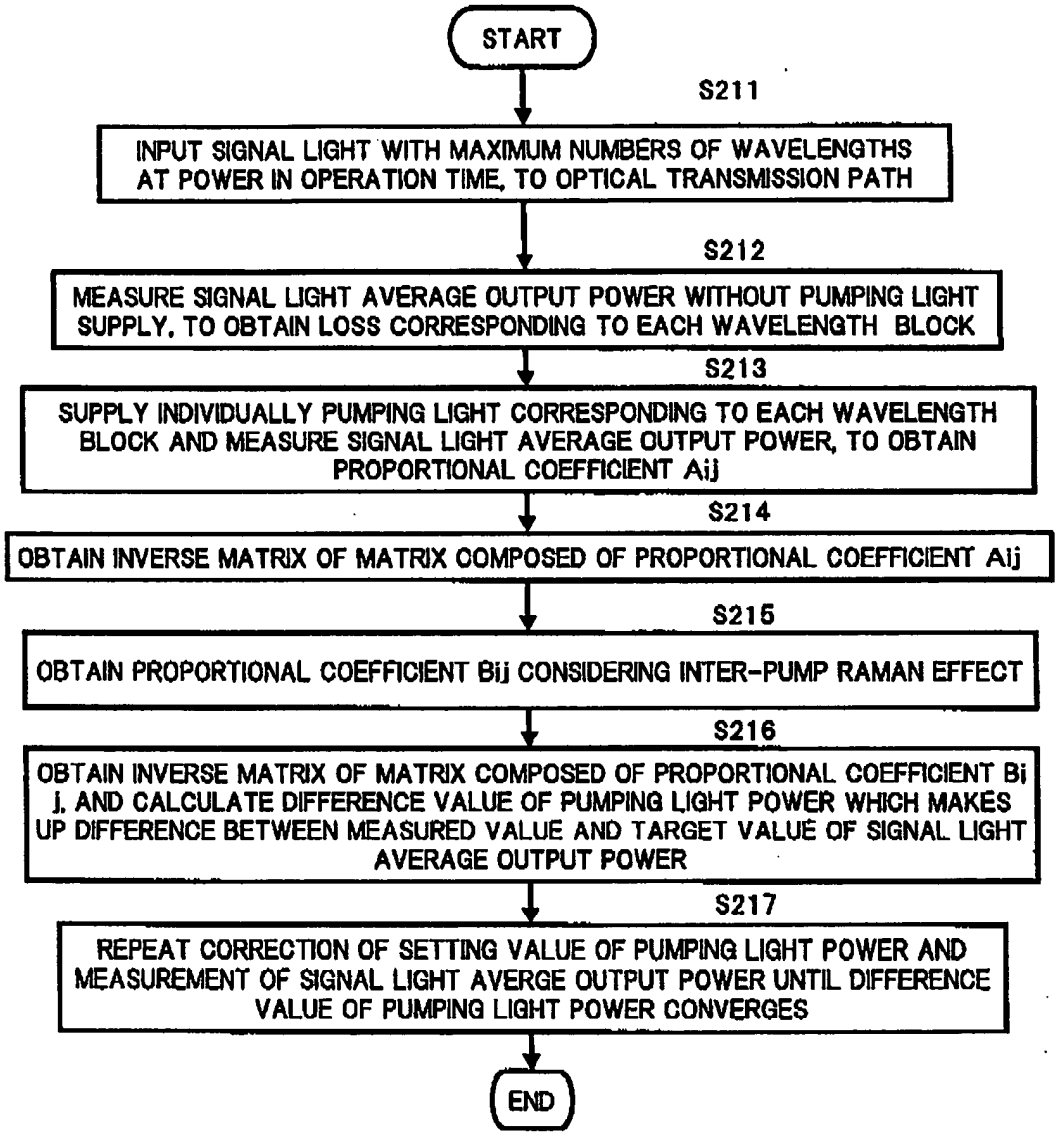


FIG.19

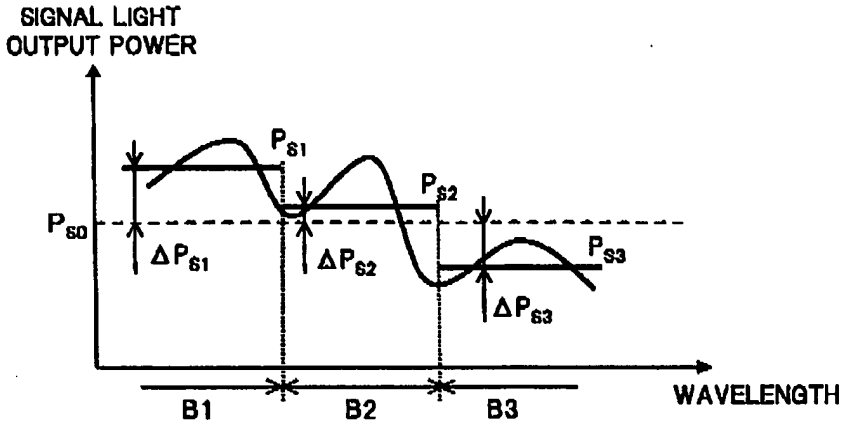

SIGNAL LIGHT
OUTPUT POWER
P_{S1}
P_{S2}
P_{S0}
P_{S3}
ΔP_{S1}
ΔP_{S2}
ΔP_{S3}
B1
B2
B3
WAVELENGTH

FIG.20

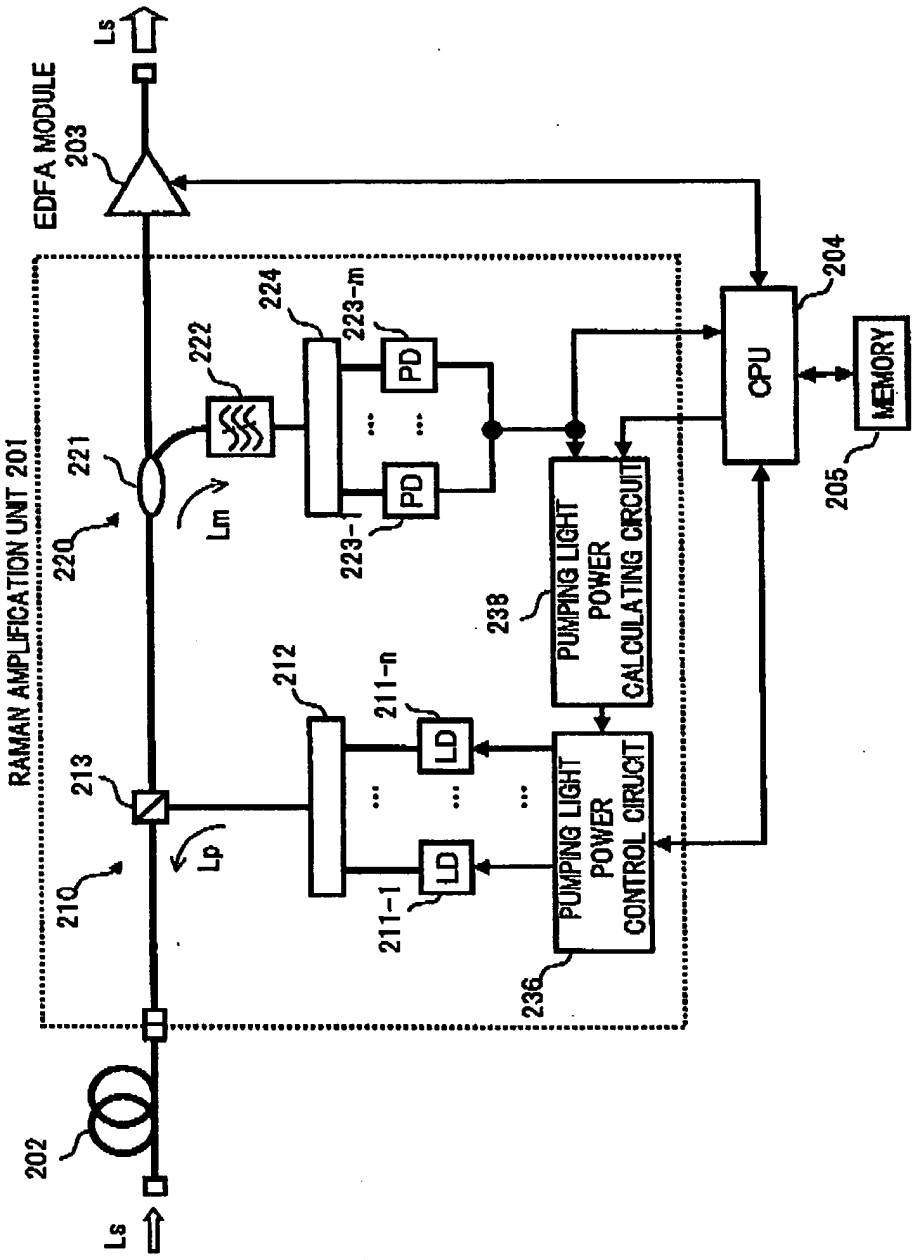

Ls
EDFA MODULE
203
RAMAN AMPLIFICATION UNIT 201
221
222
224
223-m
PD
PD
223-1
220
Lm
238
PUMPING LIGHT POWER CALCULATING CIRCUIT
204
CPU
MEMORY
205
212
211-n
LD
LD
211-1
213
Lp
210
PUMPING LIGHT POWER CONTROL CIRCUIT
236
202
Ls

FIG.21

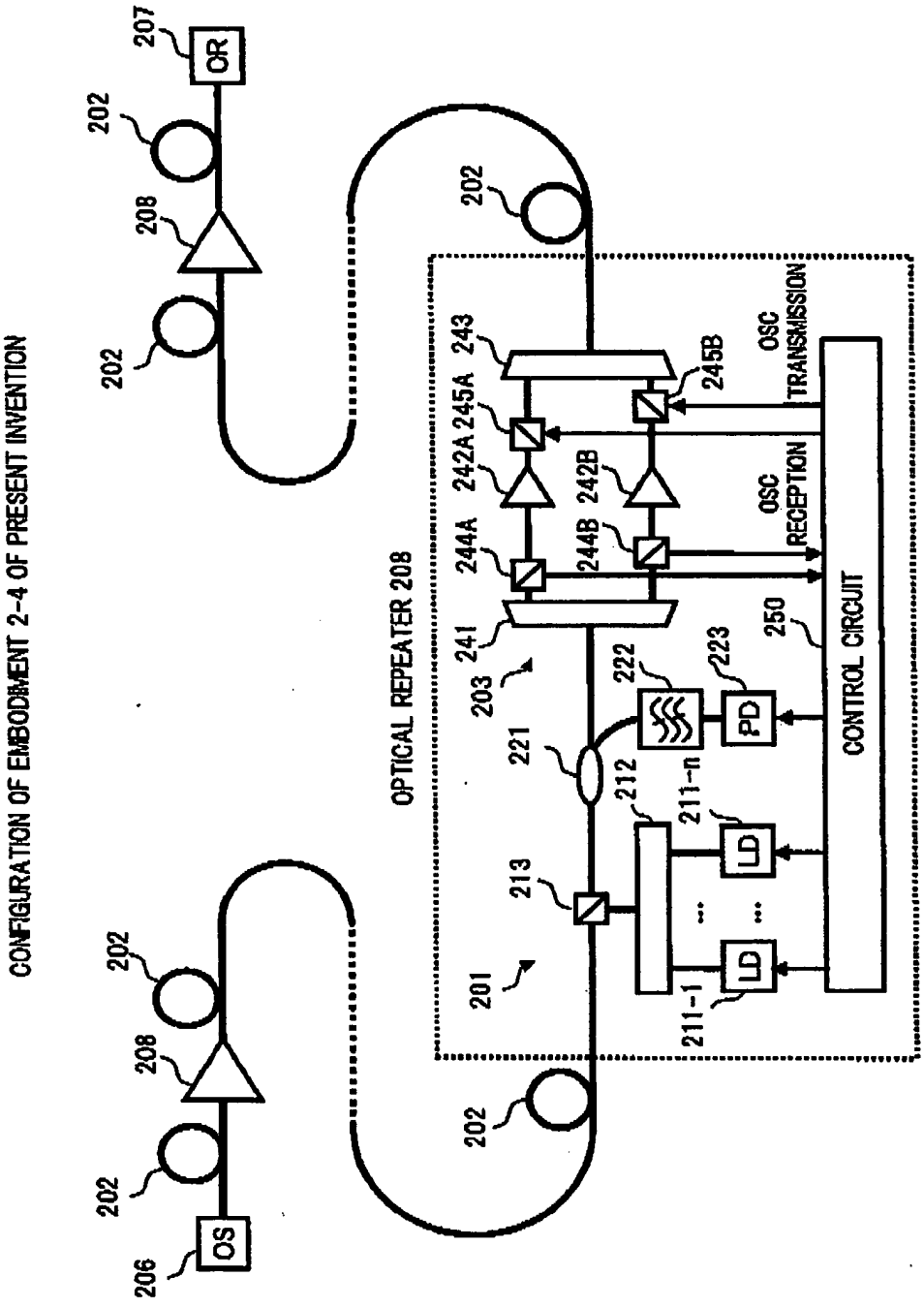

CONFIGURATION OF EMBODIMENT 2-4 OF PRESENT INVENTION
OS
OR
OPTICAL REPEATER 208
CONTROL CIRCUIT
OSC TRANSMISSION
OSC RECEPTION
PD
LD
206
207
208
201
202
203
211-1
211-n
212
213
221
222
223
241
242A
242B
243
244A
244B
245A
245B
250

FIG.22

BASIC CONFIGURATION OF EMBODIMENT 3 OF PRESENT INVENTION

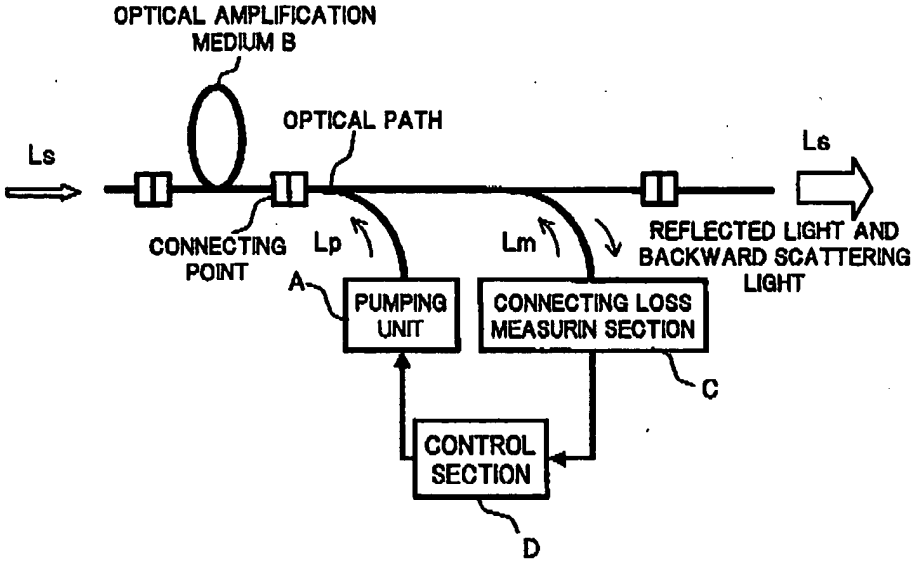


FIG.23

CONFIGURATION OF EMBODIMENT 3-1 OF PRESENT INVENTION

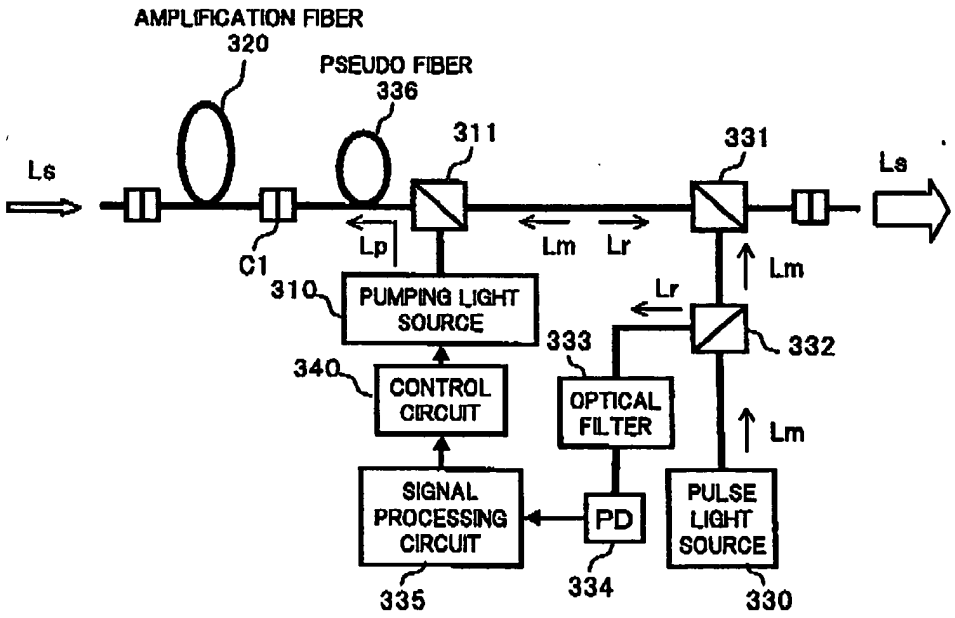


FIG.24

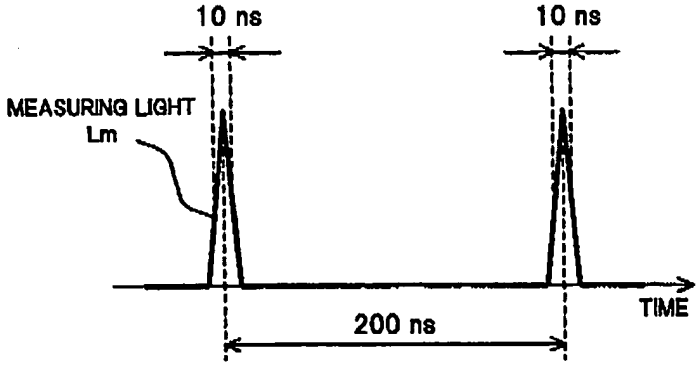


FIG.25

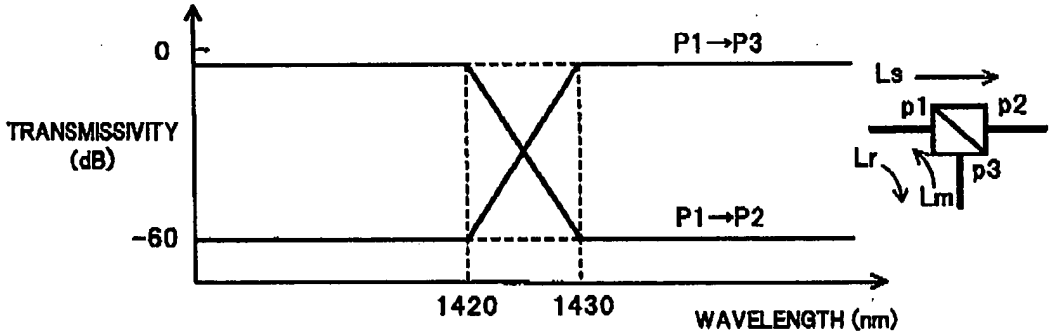


FIG. 26

TYPICAL OTDR MEASURING SYSTEM

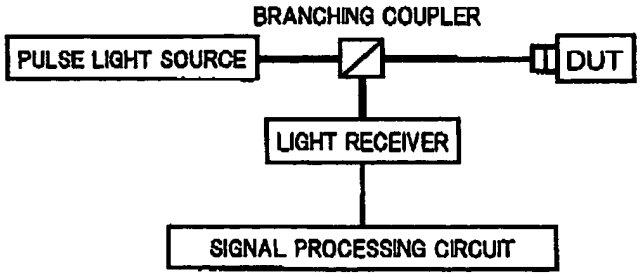
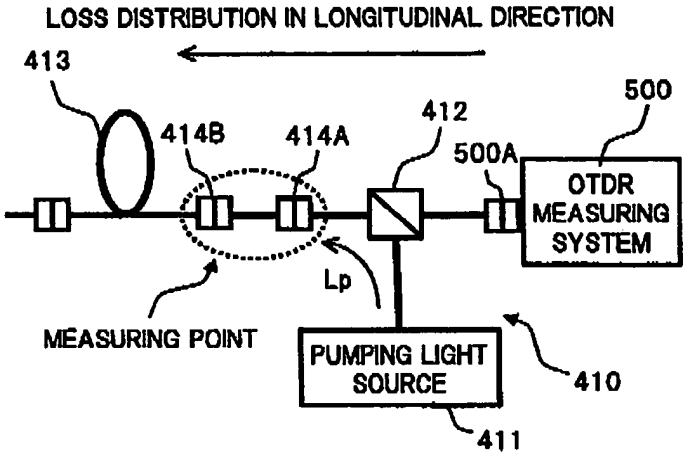


FIG.27

APPLICATION EXAMPLE OF OTDR MEASURING SYSTEM

(A)



(B)

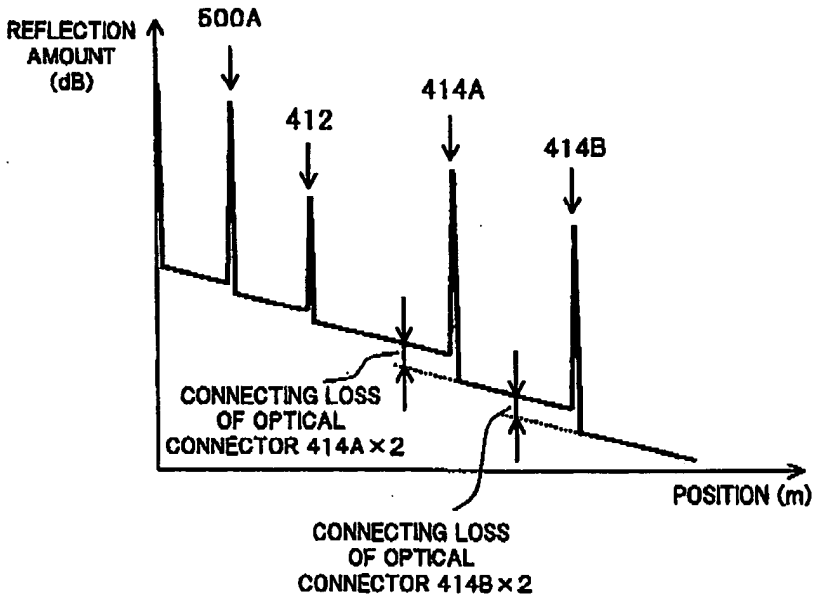


FIG.28

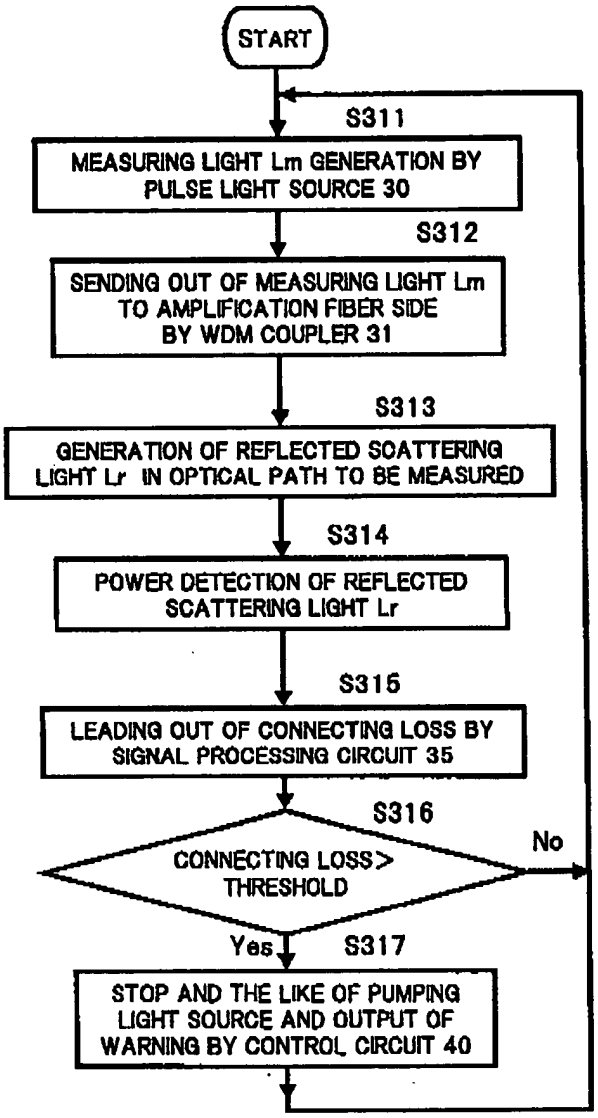

START
S311
MEASURING LIGHT Lm GENERATION BY PULSE LIGHT SOURCE 30
S312
SENDING OUT OF MEASURING LIGHT Lm TO AMPLIFICATION FIBER SIDE BY WDM COUPLER 31
S313
GENERATION OF REFLECTED SCATTERING LIGHT Lr IN OPTICAL PATH TO BE MEASURED
S314
POWER DETECTION OF REFLECTED SCATTERING LIGHT Lr
S315
LEADING OUT OF CONNECTING LOSS BY SIGNAL PROCESSING CIRCUIT 35
S316
CONNECTING LOSS> THRESHOLD
No
Yes
S317
STOP AND THE LIKE OF PUMPING LIGHT SOURCE AND OUTPUT OF WARNING BY CONTROL CIRCUIT 40

FIG.29

CONFIGURATION OF EMBODIMENT 3-2 OF PRESENT INVENTION

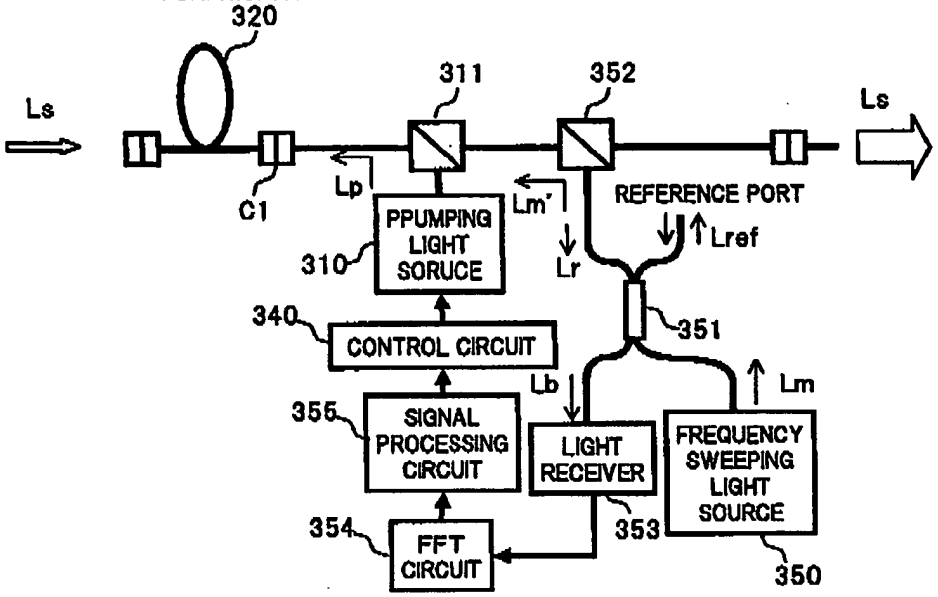


FIG.30

TYPICAL OFDR MEASURING SYSTEM

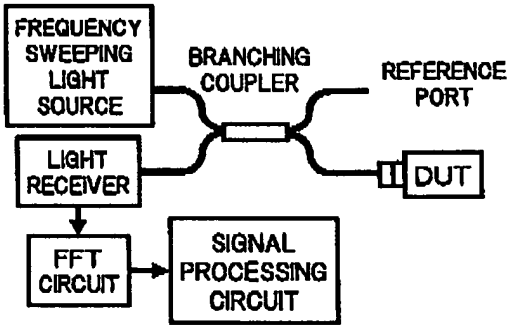


FIG.31

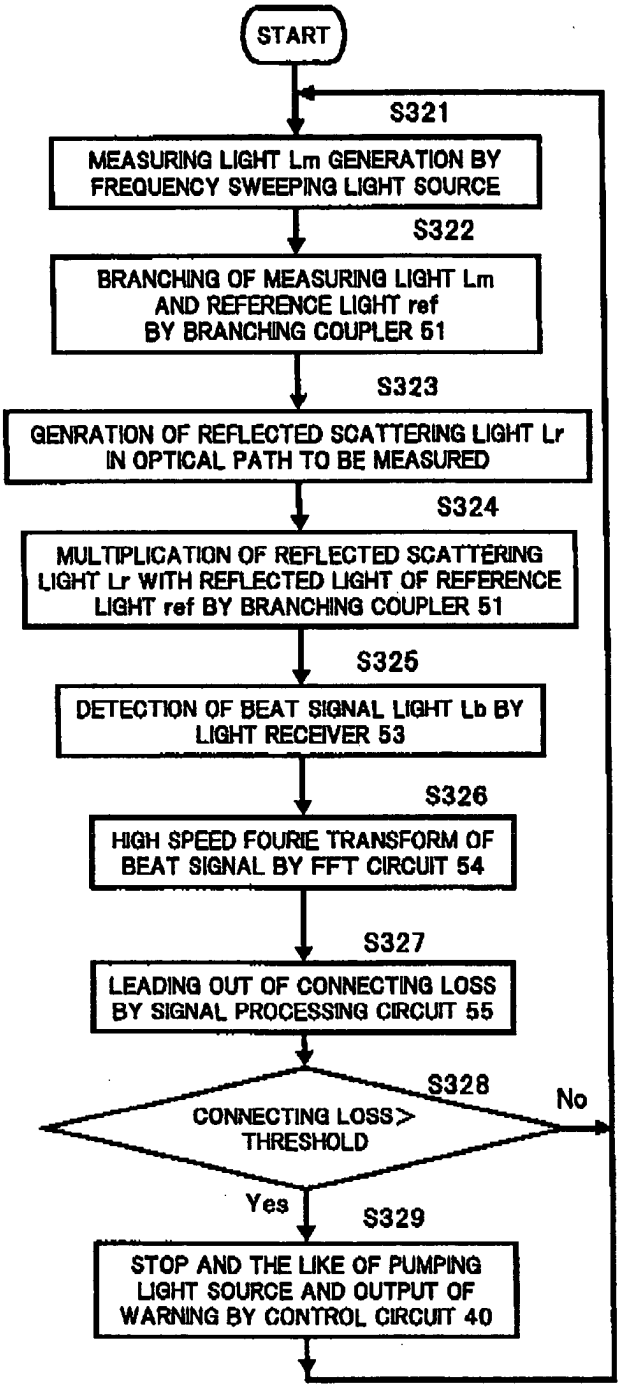

START
S321
MEASURING LIGHT Lm GENERATION BY FREQUENCY SWEEPING LIGHT SOURCE
S322
BRANCHING OF MEASURING LIGHT Lm AND REFERENCE LIGHT ref BY BRANCHING COUPLER 51
S323
GENRATION OF REFLECTED SCATTERING LIGHT Lr IN OPTICAL PATH TO BE MEASURED
S324
MULTIPLICATION OF REFLECTED SCATTERING LIGHT Lr WITH REFLECTED LIGHT OF REFERENCE LIGHT ref BY BRANCHING COUPLER 51
S325
DETECTION OF BEAT SIGNAL LIGHT Lb BY LIGHT RECEIVER 53
S326
HIGH SPEED FOURIE TRANSFORM OF BEAT SIGNAL BY FFT CIRCUIT 54
S327
LEADING OUT OF CONNECTING LOSS BY SIGNAL PROCESSING CIRCUIT 55
S328
CONNECTING LOSS> THRESHOLD
No
Yes
S329
STOP AND THE LIKE OF PUMPING LIGHT SOURCE AND OUTPUT OF WARNING BY CONTROL CIRCUIT 40

FIG.32

CONFIGURATION OF EMBODIMENT 3-3 OF PRESENT INVENTION

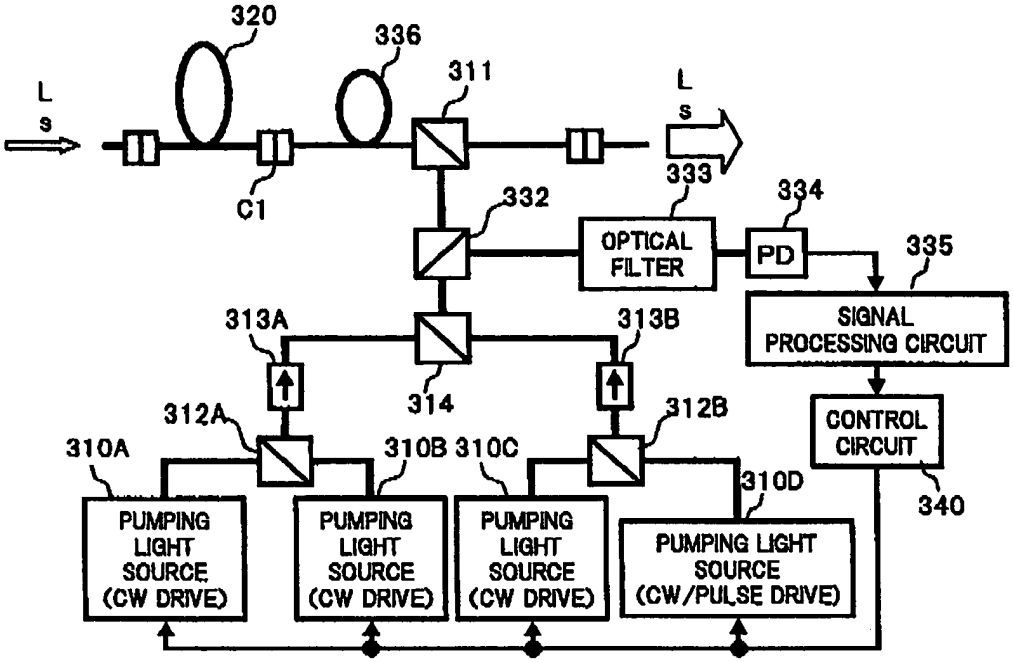


FIG.33

CONFIGURATION OF EMBODIMENT 3-4 OF PRESENT INVENTION

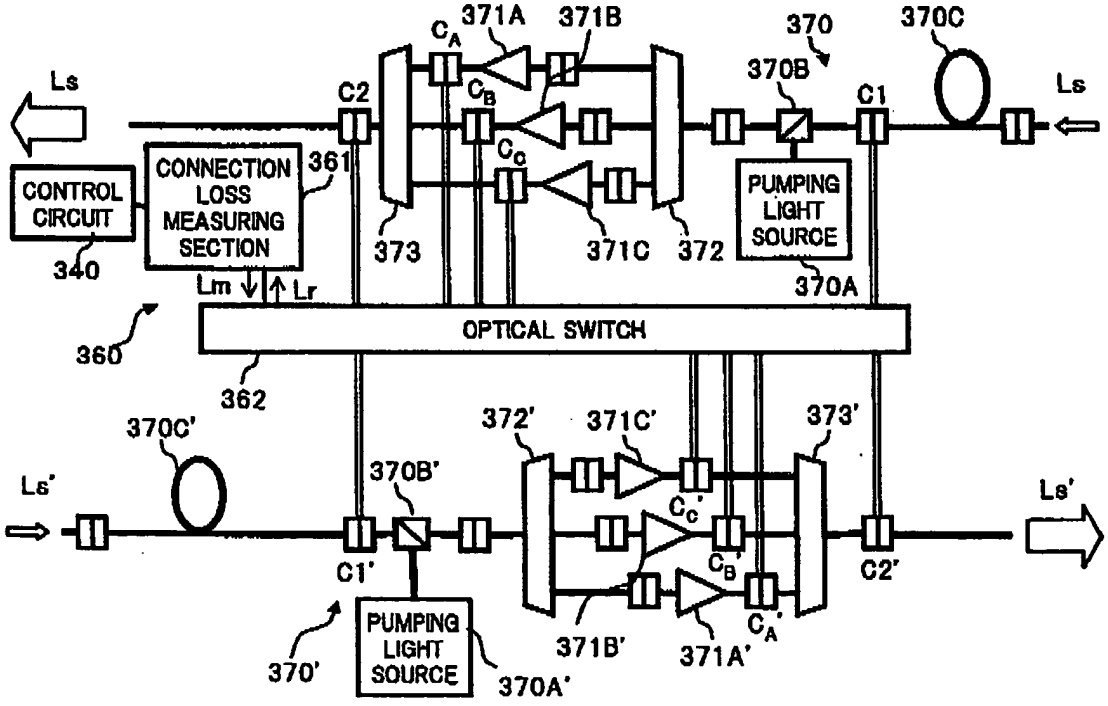


FIG.34

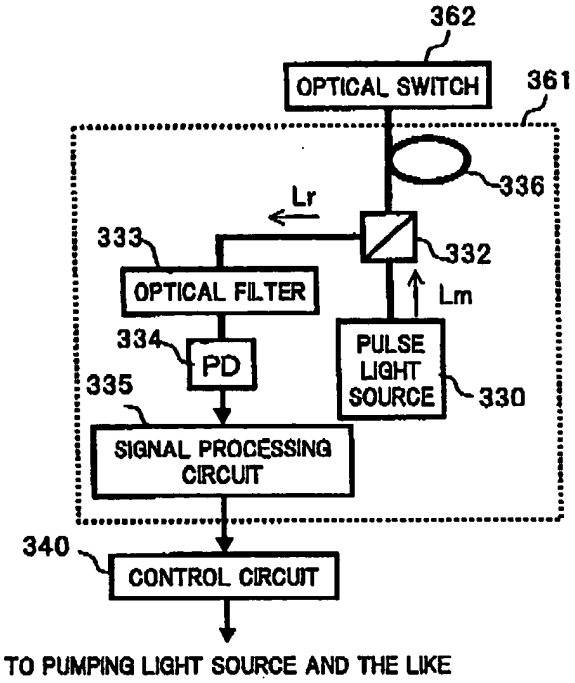


FIG.35

CONFIGURATION OF EMBODIMENT 3-5 OF PRESENT INVENTION

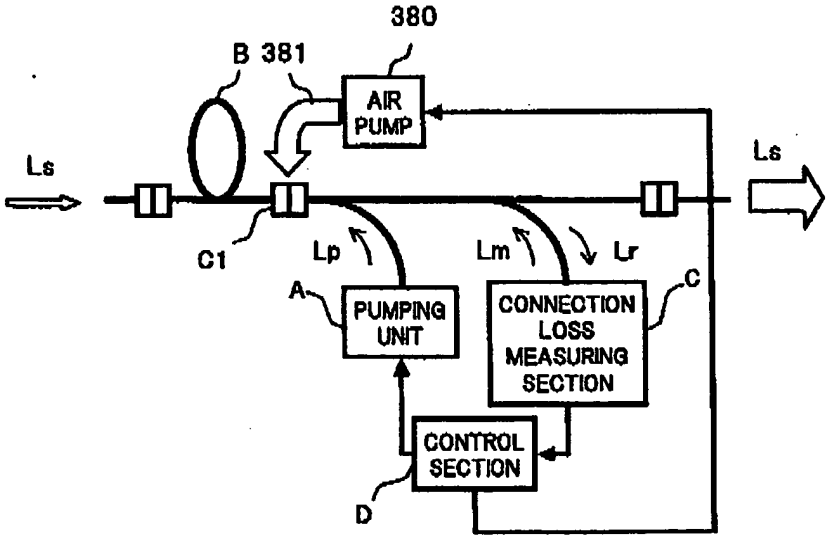


FIG.36

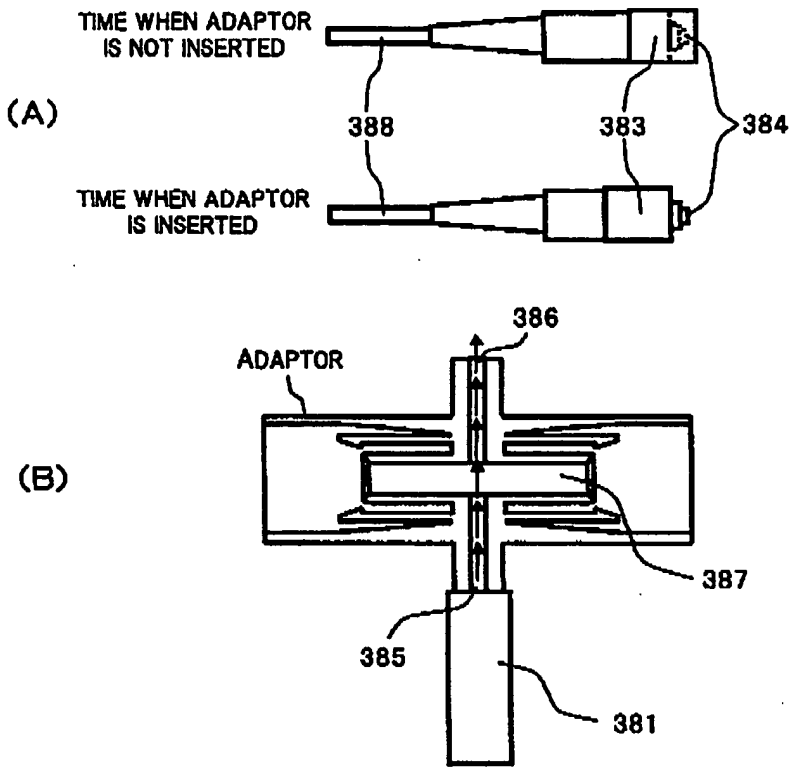

TIME WHEN ADAPTOR IS NOT INSERTED
(A)
388
383
384
TIME WHEN ADAPTOR IS INSERTED
386
ADAPTOR
(B)
387
385
381

FIG.37

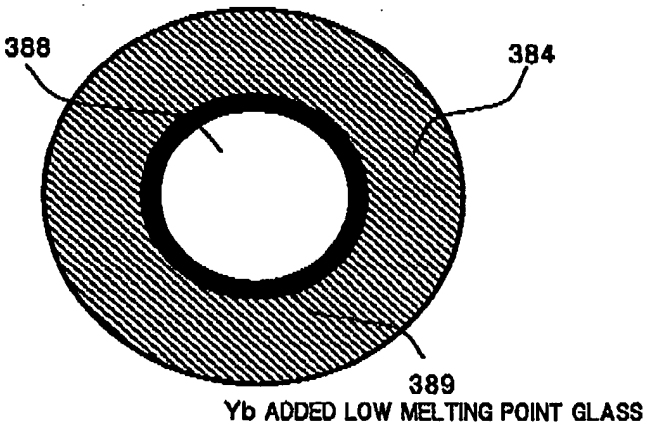

388
384
389
Yb ADDED LOW MELTING POINT GLASS

FIG.38

BLOCK DIAGRAM OF OPTICAL TRANSMISSION SYSTEM USING TYPICAL RAMAN AMPLIFIER

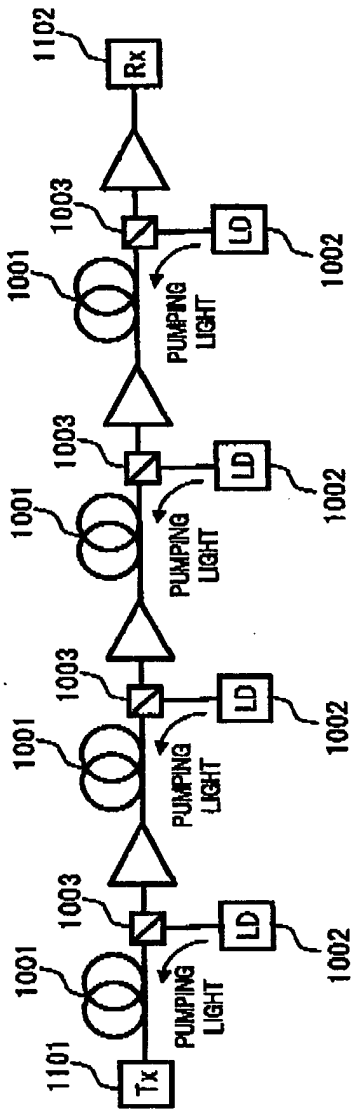


FIG.39

RELATED ART

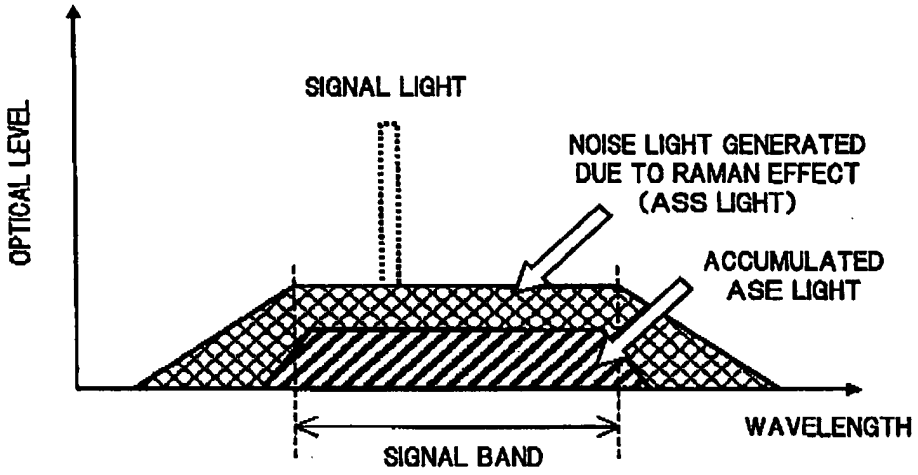


FIG.40

RELATED ART

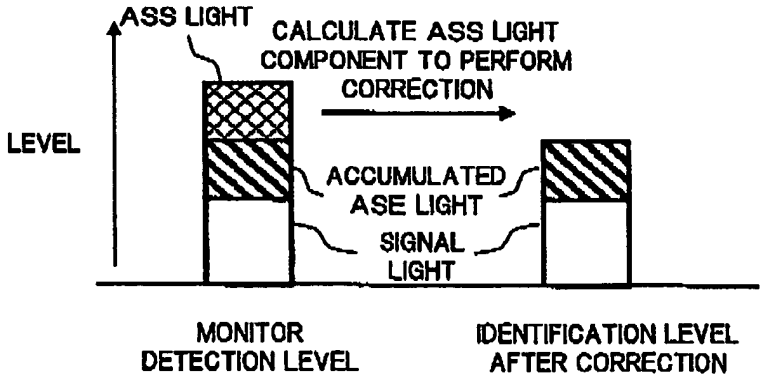


FIG.41

RELATED ART

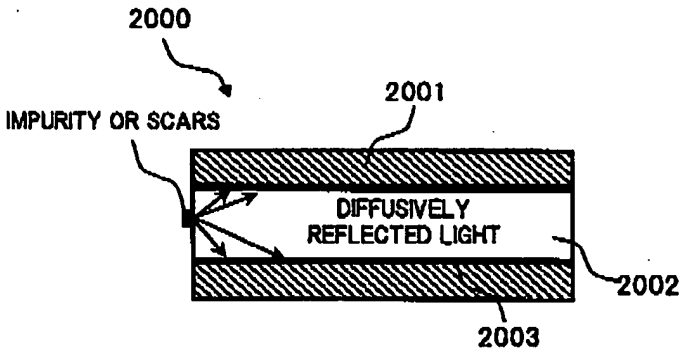


FIG.42

RELATED ART